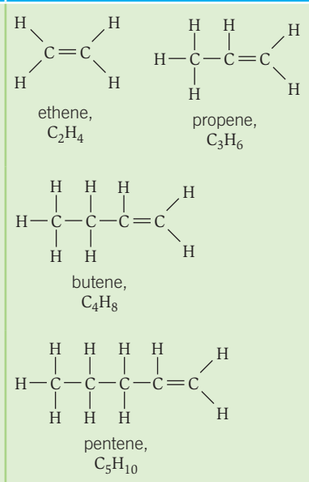
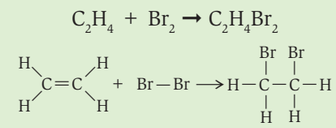
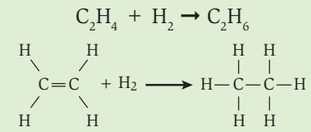
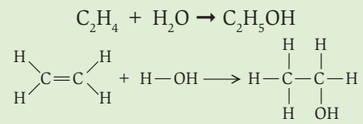
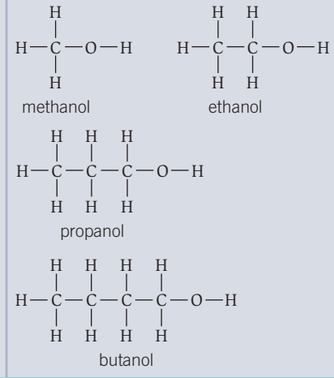
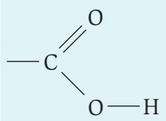
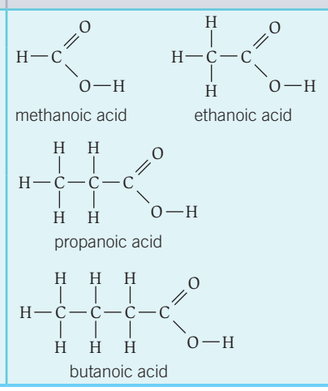
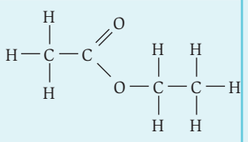
Chapter 10: Organic reactions

Knowledge organiser

Organic chemistry

There are lots of different 'families' of carbon-containing compounds, for example, alkanes and **alkenes**. These families are called a **homologous series**. Each compound within a homologous series has similar properties and reactions. They all contain specific atoms in specific orders, called the **functional group**.

Homologous series	Functional group	First four of homologous series	Formation	Uses	Combustion reaction	Other reactions	Other information
alkenes		 ethene, C_2H_4; propene, C_3H_6; butene, C_4H_8; pentene, C_5H_{10}	cracking	• formation of polymers • a chemical feedstock	• complete combustion produces carbon dioxide and water • incincomplete combustion more likely, resulting in a smoky yellow flame • both types of alkene combustion release less energy per mole than alkanes	**Addition with halogens** The two atoms from the halogen molecule are *added* across the carbon – carbon double bond.  **Addition with hydrogen** The two atoms from the hydrogen molecule are *added* across the carbon – carbon double bond to form an alkane.  **Addition with steam** React with steam at high temperature and pressure in the presence of a catalyst to form alcohols. 	Alkenes are called **unsaturated** because they have double bonds. As such, atoms can be added to the molecule by breaking the double bond. This contrasts with alkanes which are called **saturated** as there is no space to add more atoms. Alkenes have a general formula C_nH_{2n}.
alcohols	–OH	 methanol; ethanol; propanol; butanol	Ethanol can be formed from the **fermentation** of sugar – warm a sealed mixture of yeast and a sugar solution. glucose → ethanol + carbon dioxide $C_6H_{12}O_6(aq) \rightarrow 2C_2H_5OH(aq) + 2CO_2(g)$	• *ethanol* is used in alcoholic drinks • first four alcohols mix easily with water, so are used as solvents for substances that don't dissolve in water • common in perfumes, aftershaves and mouthwashes	• short alcohols are very effective fuels and combust easily, burning with a blue flame and producing carbon dioxide and water $2CH_3OH + 3O_2 \rightarrow 2CO_2 + 4H_2O$	**Reaction with sodium** Alcohols react with sodium to release hydrogen. The product from this reaction is called an **alkoxide**, which if added to water forms a strongly alkaline solution. **Oxidation** Alcohols can react with **oxidising agents**, like potassium dichromate, to form carboxylic acids.	Alcohols are highly flammable and must not be handled near naked flames.
carboxylic acids		 methanoic acid; ethanoic acid; propanoic acid; butanoic acid	oxidation of alcohols	• ethanoic acid is used in vinegar	• carboxylic acids can undergo combustion, but we do not generally do this or use them as a fuel	Carboxylic acids react in the same way as other acids. **Reaction with sodium carbonate** Carboxylic acids react with bases to form salts. For example, carboxylic acids react with a metal carbonate to produce a salt, carbon dioxide, and water. **Reaction with alcohols** Carboxylic acids react with alcohols to make water and **esters**. The reaction requires sulfuric acid as a catalyst.  Esters have distinctive smells and are used in perfumes and flavourings. The product of ethanol and ethanoic acid is ethyl ethanoate.	(HT only) When added to water, carboxylic acids are partially ionised to form weakly acidic solutions. They are weak acids.

Key terms

Make sure you can write a definition for these key terms.

addition reaction · *alcohols* · *alkene* · *alkoxide* · *carboxylic acid* · *ester* · *fermentation* · *cracking* · *functional group* · *homologous series* · *oxidation* · *oxidising agent* · *saturated* · *unsaturated*